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Listening Effort and Cognitive Decline: An Exploratory Study Using Pupillometry

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PhD: Listen Care-fully: Healthcare Design on Listening Effort and Cognitive Function

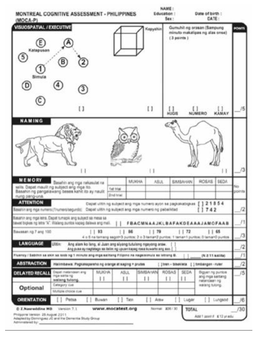
Project period: 2019 March – 2022 February

Background

- Around **50 million people** have dementia worldwide with nearly **10 million new cases** every year[1]
- Hearing impairment accounts for **9% of the predictive power** of all risk factors associated with the development of dementia[1]
- Hearing loss is proposed as a **potentially modifiable risk factor** for dementia in midlife[1]
- Even **mild levels of hearing loss** increase the long-term risk of cognitive decline and dementia in individuals who are cognitively intact but hearing impaired at baseline.[2]
- The **mechanism underlying cognitive decline** associated with peripheral hearing loss is not fully clear[1]
- Research suggests a potential pathway between hearing and cognitive decline, with **listening effort, working memory and cognitive load** as principal mediators.[3]

Research questions

- Is there an association between listening-effort, assessed by pupillometry, and cognitive function?
- Can the use of hearing aids reduce listening effort, and would this translate to improved performance on cognitive tests?
- Could cognitive health management practices be re-designed to account for audiology-related risks of cognitive decline?



Why measure listening effort?

A growing amount of research is using pupillometry to examine listening effort and indicate the availability or demand on cognitive resources during processing.[4-7] Reports of effortful listening suggest that these difficulties are about more than sounds being too quiet or non-audible. These individuals may need to allocate more cognitive capacity to comprehend, remember and respond to auditory information.[5] The pupil diameter enlarges with this increased mental effort and reflects the processing demands associated with the task in relation to available cognitive resources.[7]

Objectives

- Determine whether increased listening effort is associated with cognitive function
- Investigate the feasibility of integrating listening effort technology as a predictive tool at point-of-care in dementia and hearing care settings

What is the intervention?

Subjects

- Two groups of healthy, middle-aged and older individuals (1: aged 60-80, 2: aged 40-60)
- One group of older individuals (aged 60-80) with Mild Cognitive Impairment (MCI)

Eligibility

- Pure Tone Audiometry (PTA), age-matched, to rule out significant hearing loss
- Based on the broad Winblad criteria, control participants have a Mini-Mental State Examination (MMSE) score of 28 or higher

Study 1: Clinical research

- Speech intelligibility and pupil dilation will be measured during a Hearing in Noise test (HINT).
- Cognitive function will be measured using a battery of attentional and memory-based cognitive tests.
- Those who demonstrate high levels of listening effort in noise will be fitted with hearing aids and re-tested on cognitive performance after 3 months of use

Study 2: Integrative care research

- Could basic audiological testing be integrated in the management of cognitive impairment?
- Prototyping the integration of listening effort testing with dementia care professionals
- Investigating the impact on the patient journey, and factors such as training, costs and usability

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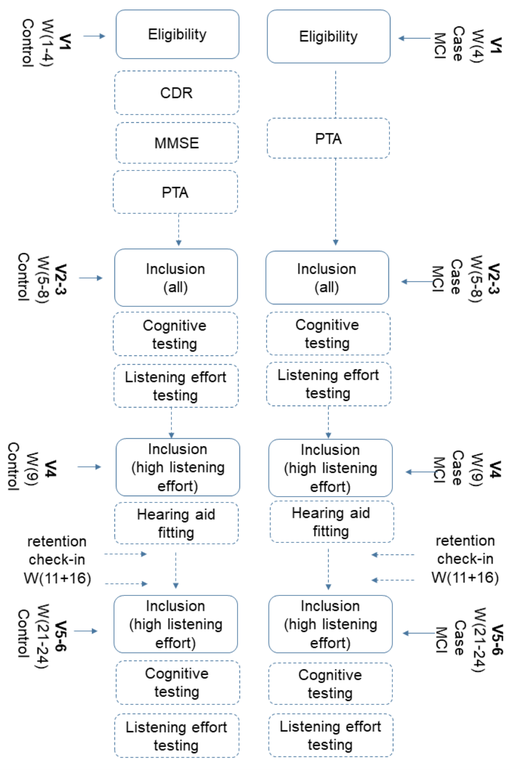
Scan to learn more about the project

Study 1 – Clinical research



Collaborating partners

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